

Understanding Sensory Integration Issues

*Many thanks to Denise Nelson, O.T.R., for her technical review and helpful suggestions.

What Is Sensory Integration?

The brain and nervous system receive input from body parts as well as from the outside world. The central nervous system is also a means of transmitting messages throughout the body and functions somewhat like a computer system. The messages that are transmitted, however, affect functions such as muscle movement, coordination, learning, memory, emotion, behavior and thought. As with a computer, a breakdown or malfunction in one part of the system often affects other functions of the system.

Sensory integration (S.I.) is the body's ability to:

1. Receive or take in sensory stimuli
2. Interpret the stimuli
3. Process the stimuli into a response; and
4. Adaptively respond to the stimuli

The sensory system takes information from the surrounding environment through touch, smell, sound, vision, taste, movement and gravity. It processes or interprets these sensations together to make sense of the environment. The process of sensory integration lays the foundation for efficient operation of the nervous system and other parts of the body that respond to the signals sent by the nervous system.

The prevailing medical theory is that a neurophysiological mechanism lowers the general coping ability of the nervous system so that a person with sensory impairment is more vulnerable to a particular stimulus and experiences more stress than normal when confronted by that stimulus. The reaction can affect one's attention and emotions. Over-responsiveness can cause headaches, nausea, disorientation, aggressive behavior, fear or unwillingness to attempt new activities. Under-responsiveness can cause one to have difficulty moderating body temperature or staying alert.

A child whose nervous system is over-aroused (**hyper-arousal**) may benefit from techniques that help the nervous system to calm down and to focus on the activity at hand rather than on the reaction to the stimulus. Successful techniques include: wearing a specially designed vest that has weights sewn into it; using a special brush to stroke the arms with firm pressure, proximal to distal, i.e. away from the trunk area (called "brushing"); being wrapped tightly in a blanket or having someone wrap their arms gently but firmly around the child's upper body and holding the child for a few minutes; having someone place a firm hand on the child's shoulder; or rubbing the upper back area in a circular motion. Chewing gum may help some children to concentrate better.

A child whose sensory system is under-aroused (**hypo-arousal**) is not able to make the best use of new information or the learning environment itself because the child's sensory system is "asleep." A child with this type of sensory dysfunction may require some physical activity to "awaken" his or her nervous system. Activities such as bouncing on a ball, dancing, jumping rope, singing or doing rhythmic movements can help a child to arouse the nervous system sufficiently to focus on and participate in the learning activities that occur in the classroom.

The Sensory Integration System Is Multi-Dimensional

There are several dimensions to the sensory integration system. The **tactile system**, which is the portion that processes stimuli in the form of touch, has two levels. The first is **discrimination**, which allows a child to determine where the touch occurs on the body and what is touching the body. The second level alerts the child's central nervous system and tells it when the body is in contact with danger. This second level is sometimes called the "**fight or flight**" response.

These two levels must work harmoniously as they are important for the interpretation of information and for survival. Dysfunction at either of these levels is called **tactile defensiveness** and can manifest itself in the following ways: difficulty with fine motor tasks such as letter formation (writing) or articulating sounds; being touched by others; dislike for the texture of clothing; dislike of the texture or flavor of certain foods; overactivity or underactivity; dislike of "dirty" hands; a high tolerance for pain; the need to touch another person or object constantly.

Another important dimension of the central nervous system is the **vestibular system**. This system involves the body's sense of movement and gravity or the relationship between one's own body and the earth, i.e., what way is up, down, left, right, horizontal, vertical, etc., and where is the body in relationship to other objects such as a ball, the sidewalk, or stairs. This system also tells the body whether or not it is moving, how fast it is moving and in what direction it is moving.

The vestibular system is responsible for the development of eye movements to track objects (words on page, a ball in the air); movement of body parts in unison; **bilateral coordination** (the ability to use both sides of the body for activities such as hopping, jumping, catching); and development of right or left handedness. Dysfunction in this system may manifest itself in poor physical coordination; poor memory (due to difficulty with **auditory processing**, or receiving and understanding auditory stimuli as it is transmitted to the brain); difficulty with sequencing and timing (understanding the steps required to perform a certain action); and difficulty with understanding language, especially nonverbal social language (body language of self and others). Children with dysfunction in this dimension often need to move their bodies in order to be able to listen

and understand when directions are being given or new information is being introduced. A child with vestibular dysfunction may experience gravitational insecurity when on surfaces such as gravel, textured cement or metal grates. The child may have exaggerated emotional reactions or behaviors when confronted with ordinary stimuli.

The last of the three dimensions is the **proprioceptive system**. Through this system the child receives information from the muscles, joints, and tendons telling the body where it or the particular body part is at any given moment. A typically developing child begins to demonstrate **praxis**, or the ability to take in sensory information and organize, plan and execute physical responses, at around 7 to 8 months of age. These abilities include: **imitation** (through vocalizations, facial expressions, and body movements such as sticking out one's tongue); **initiation** (beginning an activity that requires a physical response); **construction** (the ability to put objects together or organize them in different ways or remember supplies that are needed for a task); **feedback** (creation of muscle "memory"); **grading** (the ability to vary the intensity of one's motor response); **timing and sequencing** (performing motor responses in the correct order, at the right time and without stopping); and **motor planning** (the ability to create, use and combine motor skills to perform new and more complex tasks with practice). Children who have difficulty with one or more of these aspects of praxis often appear to be clumsy, accident prone or uncoordinated.

How Does S.I. Dysfunction Affect Learning?

A child's alertness and thus the availability for learning may be impacted. A child with sensory integration dysfunction may be unable to maintain a state of arousal or alertness that is sufficient for taking in the ordinary sensory stimulation that is presented in the classroom or learning environment. If the child's arousal is too low the child may appear tired, lazy or distracted. If the child's state of arousal is too high, the child may be in constant motion and may appear agitated. An abnormal state of arousal affects a child's impulse control.

A child with S.I. dysfunction may become very frustrated with reading, spelling, written or oral language, even though the child has the mental ability to learn and produce the material requested. Social interactions with peers may also be impaired.

Although sensory integration dysfunction is not the reason for every child's learning problems, many children with learning problems do have some type of sensory integration concerns. If a child displays problems with learning, behavior or motor skills, it is important that the child be evaluated for possible sensory integration dysfunction. An **occupational therapist** (O.T.) certified in sensory integration evaluation can usually determine if the child has any sensory integration dysfunction that may impact the child's learning.

How is a Child Evaluated for S.I. Dysfunction?

An occupational therapy evaluation might include: (1) assessment of the child's developmental skills; (2) quality of response to a variety of sensory input; (3) clinical observation of muscle tone, postural reflexes, eye-hand coordination, and ability to cross the mid-line (an imaginary line drawn down the center of the body); (4) hand preference (right or left hand); and (5) overall performance on physical tasks as measured against same-age peers. One important area of assessment is the reaction of the child to incoming sensory stimuli that the typical child would likely ignore or to which the typical child would show only a minimal reaction. The evaluator would also look at the child's ability to focus on or "inhibit" stimuli, i.e., focus attention on a task at hand while being able to ignore or "tune out" other stimuli such as sounds, pictures, or movement in the child's environment.

What Is a Sensory "Diet?"

Using techniques to calm a hyper-aroused system or stimulate a hypo-aroused system when done in a prescribed routine or scheduled manner rather than a random manner is called a **sensory diet**. A child may require such a diet during the school day. An occupational therapist, physical therapist, physician or nurse may provide the guidelines for a sensory diet. A therapist or the parent can train the staff to administer the diet during the school day. Most schools have the necessary equipment to implement a sensory diet. Occasionally, however, parents may be asked to provide a unique item for the child's use at school.

How Does Sensory Integration Dysfunction Impact Motor Function?

Some children with sensory dysfunction have weak muscle tone and may experience difficulty carrying out a motor response in a systematic and fluid manner. This is due to the fact that the nervous system does not respond appropriately or quickly to directions being sent from the brain to the muscles involved. This affects different children in different ways. For example, some children may be unable to speak clearly or answer quickly; others may require several minutes to carry out the proper motor response, such as being asked to write a specific spelling word on the paper when the teacher says the word out loud.

When a task requires one or more physical steps to complete, the brain must communicate each step in the process through neurons. This process is called **motor planning**. It involves several steps: (1) the ability to visualize or make a plan to act; (2) the ability to perform steps in the task in the proper sequence; and (3) the ability to execute the tasks in a coordinated manner, making adjustments as the feedback requires.

If some of the connections in the nervous system are weak or faulty, the message may have to be repeated by the brain several times before the muscles get the complete message. Children with motor planning difficulties may need additional **processing time** or **response time** between when the instruction is given and when the task is completed.

Summary

The nervous system directs many voluntary and involuntary activities of the body. It is the gateway for external environmental stimuli to the rest of the human body and thus is integral to a child's ability to learn. When any part of the system is not working properly, whether overreacting, underreacting or dysfunctioning in some other way, the entire system may be affected. A child who experiences sensory integration problems to the extent that they interfere with learning or development requires individualized programming to help the child minimize the impact of those problems on the learning process and the child's social interactions. The strategies used, e.g., the sensory diet, or the therapy provided for improving the functioning of the sensory system, should be identified in the child's Individual Family Service Plan (IFSP) or Individual Education Program (IEP) so that everyone is working together to improve the child's receptivity to the learning environment. Communication and coordination of efforts among private service providers, school service providers and parents are equally important.

Resources

There are many resources on sensory integration. Some recommendations include: The Out of Sync Child: Coping with Sensory Integration Problems, by Carol Stock Kranowitz (1998); SenseAbilities: Understanding Sensory Integration, by Maryann Colby Trott, Therapy Skill Builders (1-800-228-9752); Sensory Integration and the Child, by A. Jean Ayres (1979), Western Psychological Services; the American Occupational Association, (301) 652-2682; Sensory Integration International, (310) 320-9986. The Arc/JC has also recently purchased the videotape "Roots & Wings: Sensory Processing for Parents." This is an excellent video (30 minutes) available for viewing at the Arc in the resource library.